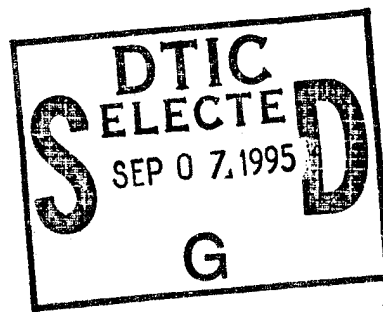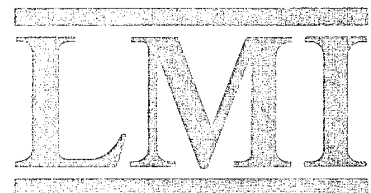Logistics Management Institute

# Exchanging Material Safety Data Sheets via Electronic Data Interchange: A Prototype

NA204MR2

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LOGISTICS MANAGEMENT INSTITUTE

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via Electronic Data Interchange:
A Prototype

# Executive Summary

An electronic environment offers significant advantages over paper-based processes. For the handlers and users of hazardous materials these advantages include reducing data duplication, avoiding redundant processing, and moving information faster to the people who need it. To test the feasibility of electronic processing to manage material safety data sheets, we designed a prototype system. The prototype enables a manufacturer or supplier to transmit a material safety data sheet to the Navy's processing focal point using electronic data interchange; to automatically parse the document and append it to a prototype data base; and to link Navy procurement activities to the data base electronically.

Two Navy procurement activities and two manufacturers participated in the test, along with the Navy's focal point.

The test indicates that electronic data interchange is a viable medium for transmitting material safety data sheets, and that their transmitted data can be electronically stored, reproduced, and manipulated to support queries, analysis, and management reporting. Based upon the test, we recommend that the Navy use electronic data interchange as a vehicle for transmitting material safety data sheets and convert its paper-based processing of them to a fully electronic system.

In support of that recommendation, we also recommend that the Navy do the following:

◆ Use the fully structured version of the Accredited Standards Committee X12 848 transaction set, since it allows the most detailed parsing of data.

◆ Fully evaluate the prototype system to determine desirable changes to the functionality that it provides.

◆ Aggressively seek out trading partners to exchange material safety data sheets via electronic data interchange.

◆ Review the Federal Acquisition Regulations, Federal Standard 313, Code of Federal Regulations, and relevant Department of Defense and Navy policy documents to identify changes that should be pursued in order to process material safety data sheets electronically.

- Analyze existing and emerging hazardous material management information systems to determine their requirements and enable the material safety data sheet processing system to interface with them.

- Explore other technologies and standards that may permit the Navy to move to an electronic process faster than by relying on electronic data interchange alone.

These steps will ensure a smoother path to realizing the advantages of an electronic system.

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# CHAPTER 1

# Project Overview

## BACKGROUND

In May 1994, the Logistics Management Institute (LMI) completed a study of the Navy's process for managing material safety data sheets (MSDSs). As a result of that study, we determined that the process delayed access to MSDSs for many hazardous material (HAZMAT) items until long after the item had been received — posing a threat to safety. An outdated processing architecture is the main factor delaying access to MSDSs. Without the aid of an electronic linkage, three geographically dispersed Navy activities involved in the process communicate inefficiently — exchanging MSDSs, through the U.S. mail, on paper or diskettes.

To remedy these inefficiencies, LMI recommended that the Navy use an electronic processing architecture that exploits existing telecommunications capabilities in conjunction with the use of electronic data interchange (EDI) technologies. An electronic-based environment offers significant advantages over the existing paper-based process, including reducing data replication, redundant processing, and the time required to make MSDSs available to the people who need them — HAZMAT handlers and users. The Navy agreed with our recommendations and directed us to develop a prototype system to test the feasibility of MSDS processing in an electronic environment.

## PROJECT SUMMARY

LMI conferred with the Pollution Prevention Office within the Naval Supply Systems Command and the Navy Environmental Health Center, the Navy's focal point for MSDS processing, to define the functional requirements of the prototype system. The primary requirements were to

◆ transmit electronic MSDSs,

◆ store and manipulate MSDS data,

◆ provide Navy procurement activities with read-only access to the MSDS data base, and

◆ build in the capability to expand beyond the prototype volume.

Accordingly, the prototype system was designed to enable a manufacturer or supplier of hazardous materials to transmit an MSDS to the Navy's focal point using EDI. Once received by the focal point, the EDI transaction is automatically parsed and appended to the prototype data base residing at the focal point. Navy procurement activities participating in the prototype may be electronically linked to the prototype data base; they may then query the data base at any time to determine whether an MSDS is already resident and, if so, preclude duplicate transmission.

The EDI transaction complies with the fully structured, Accredited Standards Committee (ASC) X12 848 implementation convention LMI developed under separate tasking. LMI designed the prototype data base in Microsoft Access Basic, after evaluating several commercial off-the-shelf software products and rejecting them due to their inability to perform the required functions. The data base is capable of expansion well beyond the capacity required if the system were implemented Navy-wide. LMI also developed software that enables any manufacturer or supplier to quickly and easily convert a paper material safety data sheet to an electronic file in a format acceptable for EDI.

Two Navy procurement activities and two manufacturers agreed to participate in the prototype. The Navy activities are the Fleet Industrial Support Center (FISC) Puget Sound and FISC Norfolk. The manufacturers are Chevron in Richmond, Calif., and Symtron Systems, Inc., in Fair Lawn, N.J. Chevron manufacturers and sells multiple HAZMAT products to FISC Puget Sound, while Symtron Systems, Inc. manufactures only one product that it sells to FISC Norfolk.

# RESULTS AND FUTURE DIRECTION

MSDS information was successfully transmitted from both manufacturers to the focal point data base, proving that EDI is a viable medium for electronic transmission of this data. The transmitted MSDSs were successfully appended to the prototype data base, proving that an electronically transmitted manufacturer's MSDS can be electronically stored and reproduced; and the data may be manipulated to support queries, analysis, and management reporting.

Having proven the feasibility of processing MSDSs in an electronic environment, the Navy needs to develop a strategy for employing this capability in the near- to mid-term, and in the long-term HAZMAT management environments.

In the near- to mid-term, decisions must be made about tailoring Federal Acquisition Regulation and Navy policy requirements, and the responsibilities and requirements of MSDS processing activities, to accommodate operations in an electronic rather than a paper-based environment. Additionally, the Navy must expand electronic processing to include as many manufacturers and suppliers as possible.

In the long term, the Navy must decide how the MSDS management system will interact with the DoD hazardous materials management system of the future.

The strategy and issues related to processing material safety data sheets in an electronic environment are further discussed in Chapter 4.

# ORGANIZATION OF THE REPORT

Chapter 2 describes the prototype system for Navy processing of MSDSs, Chapter 3 provides results of the prototype testing, and Chapter 4 provides recommendations concerning the prototype system. Appendix A contains the functional requirements statement LMI prepared to guide the development of the prototype system. Appendix B provides the project implementation schedule for developing the prototype system.

# CHAPTER 2

# Description of Prototype

The previous chapter presented a high-level look at the project background, summarized the concept, and briefly described the results. This chapter further describes concepts and elements basic to this study.

## CONCEPT OF OPERATIONS

The primary objective of this prototype was to validate the concept of using EDI to exchange MSDSs between trading partners and the Navy. In any effort implementing EDI, however, it is essential to examine the current business processes and identify potential areas of improvement. EDI provides the greatest benefits to organizations that seek to incorporate its capabilities into their business processes.

In the near term, however, the bulk of the MSDSs submitted to the focal point will be in hard copy form. Because of this, the Navy should choose an evolutionary strategy that will allow the focal point to accept MSDSs in several media forms. Figure 2-1 illustrates the processing architecture selected for use in this prototype, which will permit an evolutionary migration from all paper to all electronic processing.
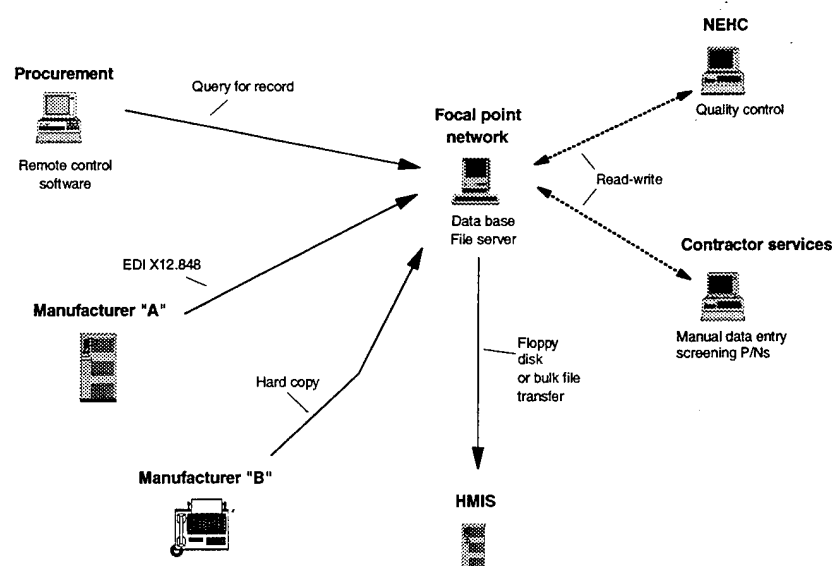


**Figure 2–1.**
*Prototype Concept of Operations*

The centerpiece of this architecture is the focal point network (FPN). The network consists of a communications gateway and application software running on a file server located at the Navy Environmental Health Center (NEHC). The focal point network would run on the existing local area network at NEHC to provide access for the various NEHC employees using client PCs. The FPN provides the functionality necessary to receive material safety data sheets in structured[1] EDI format, share the data with others on the network, and eventually export the data to a data entry system that is compatible with the Hazardous Material Information System. The network can also include any contractor services employed for the manual input of hard-copy MSDSs.

In the prototype scenario, purchasing would identify the material requirement and solicit the bids in a manner consistent with current processing. Instead of automatically collecting the MSDS for a hazardous materials purchase, however, the purchasing contracting officer (PCO) would query the data base at the FPN to determine whether that specific MSDS had already been submitted from a previous purchase. If the MSDS is already in the Navy system, the PCO can award the contract without further MSDS processing.

If a query shows that an MSDS is not in the Navy system, the PCO would request the apparently successful offeror to submit the MSDS to NEHC. (To satisfy the Defense Federal Acquisition Regulation (DFAR), a hard-copy MSDS must also be submitted to the procurement activity.) A contractor who is EDI-capable, as in the case of Manufacturer "A" in Figure 2-1, would then send an electronic MSDS to NEHC, either directly (as shown in Figure 2-1) or through a value-added network (VAN). The PCO could then verify that an MSDS was submitted by performing another query of the FPN. Other contractors, represented as Manufacturer "B" in Figure 2-1, would continue to submit MSDSs in hard copy.

# ELEMENTS OF THE PROTOTYPE

This section provides further detail about the individual elements and participants in the prototype.

## Focal Point Network

As mentioned above, the focal point network is the centerpiece of the improved processing architecture. The network in concept is simply a means to link NEHC, the contractor, and eventually other Navy activities to a common data set. This serves two functions. First, it permits parallel processing of MSDS data, which can greatly speed the document flow, particularly if other Navy "value-adding" organizations are included, such as the Ships Parts Control Center and Naval Material Transportation Office. Second, it would permit efficient

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[1] There are three different implementation conventions (ICs) widely recognized as potential vehicles for sending MSDSs via EDI. The structured IC makes maximum use of codes and data parsing, and is used primarily for automated input into a data base.

resource allocation. NEHC employees would be able to handle any electronic workload internally while routing hard-copy MSDSs to the contractor for data entry and screening.

Physically, the FPN consists of many components, two of which are addressed in detail below: the application software and the EDI software.

## APPLICATION SOFTWARE (PLASMA)

The software to be used as the Navy MSDS data base represents the single most important element of the prototype. It consists of an import interface integrated with a data base for MSDS storage. Characteristics of the application software include:

- ◆ The ability to accept structured EDI material safety data sheets, fully automating the process of data entry.

- ◆ The ability to review an inbound electronic MSDS for accuracy and quality prior to addition to the main data base. This includes the ability to check for duplicate MSDS submissions based upon manufacturer, part number, and MSDS date of preparation.

- ◆ "Upgradability" to include adding the capability to import semistructured or unstructured EDI transactions, plain American Standard Code for Information Interchange (ASCII) text files, and scanned (optical character recognition,) MSDSs.

- ◆ Graphical user interface data entry screens to speed processing of hard-copy MSDSs.

- ◆ Networking capability to allow multiple access to stored records and simultaneous data entry.

- ◆ Export capability to a variety of different application formats, including the dBase (.dbf) format consistent with the "floppy build" program currently used to interface with HMIS.

- ◆ True relational data storage, resulting in increased storage efficiency, data integrity, and query capability.

Because the Navy's process of MSDS processing is not duplicated in private industry, and because EDI has not yet been established as a dominant method for exchanging MSDSs, commercial off-the-shelf MSDS software with those characteristics does not exist. Appendix A provides a detailed description of the criteria used in formulating a "make versus buy" decision.

We developed the Prototype Long-Range Automated System for MSDS Management (PLASMA) as a Microsoft Access data base application. It is a

Windows file with the file extension of MDB (i.e., PLASMA.MDB). The data base file contains not only the MSDS tables, but the screens, reports, and unique programs as well. The application can be executed in either of two different ways, as Figure 2-2 illustrates:
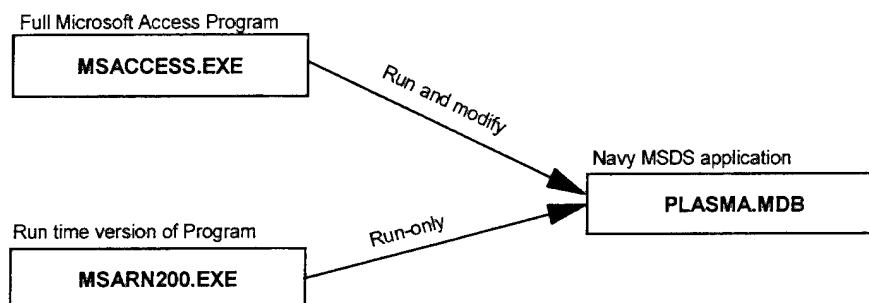
Full Microsoft Access Program

| MSACCESS.EXE |

*Run and modify*

Navy MSDS application

| PLASMA.MDB |

Run time version of Program

| MSARN200.EXE |

*Run-only*

**Figure 2–2.**
*Run Time vs. Full Program*

MSACCESS.EXE is the executable file that comes with the full version of Microsoft Access. It allows users to not only run all applications but create and modify those applications as well. MSARN200.EXE is the run-time version of Microsoft Access. If the developer of the data base application (e.g., PLASMA.MDB) purchases the Microsoft Access Developer's Toolkit, as we did, that developer may freely distribute the run-time version of Access along with the application. In this case, if the Navy decides to purchase the Developer's Toolkit, the run-time version of PLASMA could be freely distributed to procurement activities or trading partners. If users wish to purchase a full version of Microsoft Access, the Navy can freely distribute the PLASMA.MDB data base file, and users can run PLASMA from the regular program. Using either method, we are confident that the DFAR clause 252.227-7013, *Rights in Technical Data and Computer Software (Oct 1988)*, gives the government authority for such use.

PLASMA operates on an IBM-compatible personal computer. Because of the numerous calculations performed by PLASMA during any given operation, the PC should preferably be a high-speed 486-class (or higher) unit with at least 12 megabytes of random access memory. In addition, a 17-inch high-resolution monitor is necessary for those who would use PLASMA for daily editing or retrieval of MSDSs.

EDI SOFTWARE (TRANSLATOR)

In addition to application software, processing EDI transactions requires the use of EDI software, often referred to as a translator. The translator serves two basic functions. For inbound transactions, a translator converts the ANSI ASC X12-compliant transaction sent by a trading partner, in this case an ASC X12.36 848 Material Safety Data Sheet, into a format that is recognizable by the user's application software. This format is referred to as a user-defined file

(UDF). For outbound transactions, the translator performs the reverse process. It converts the outgoing UDF provided by the application software into an ANSI ASC X12-compliant EDI transaction. These processes are both represented in Figure 2-3.
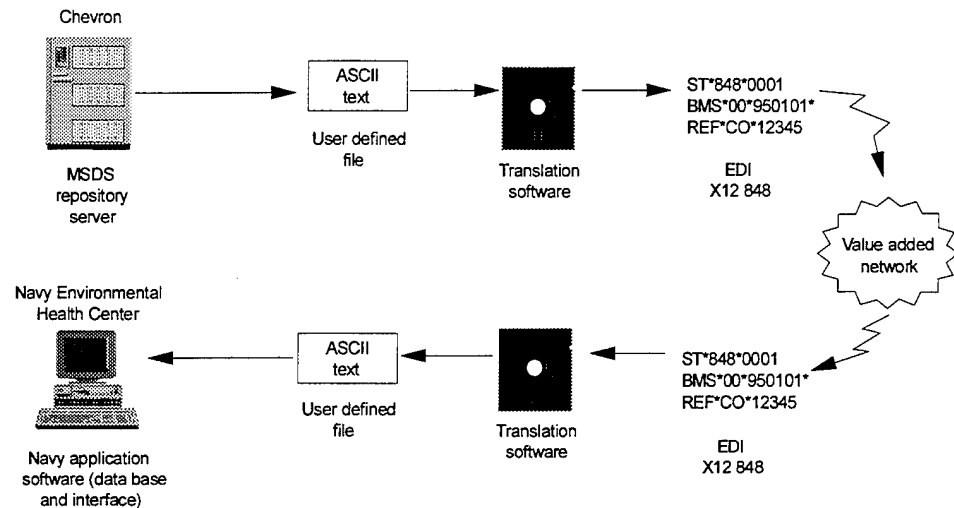


**Figure 2–3.**
*Data Flow in MSDS Electronic Transfer*

In order to perform these functions, the translator must have a "mapping solution" that defines how the application software data appear in the inbound or outbound UDF. For this project, a mapping solution has been developed to meet the requirements of the MSDS data base application software. The mapping solution and translator selected for use in the prototype, while PC-based, are consistent with the Navy and Defense Information Systems Agency (DISA) standard (Sterling Software/ABC GENTRAN Excel). For operational use, after the prototype, the mapping solution can and should be converted to a UNIX-based platform.

## Other Prototype Elements

Additional elements of the prototype include entities external to the focal point network. These entities include Navy activities participating in the project, commercial trading partners, and communication services such as a value-added network.

### Navy Activities

As previously described in this chapter under "Concept of Operations," the procurement contracting officer may be given the ability to access the data base remotely to determine whether there is an MSDS record. This can be

accomplished through the use of remote control software, which allows the PCO to "take control" of a client PC at the FPN and query for an MSDS.

Several procurement activities assisted us in testing the prototype concept. These included Portsmouth Naval Ship Yard, Norfolk Fleet Industrial Support Center, Naval Surface Warfare Center (Crane, Ind.), and Puget Sound Fleet Industrial Support Center. We contacted representatives from each activity, described the concept, and asked the representative to provide us with a sample list of their hazardous material suppliers. We then contacted those suppliers to solicit interest in participating.

TRADING PARTNERS

Trading partners were selected from a list of potential candidates that each procurement activity provided. We attempted to select trading partners as representatives from the population of Navy contractors. This population includes large, multinational corporations as well as small manufacturers and retail establishments. In addition, the degree of experience with and exposure to electronic commerce varies widely within the population. The two trading partners who agreed to participate are Chevron, USA, Inc., headquartered in San Francisco, and Symtron Systems, Inc., of Fair Lawn, N.J.

Chevron, as a large manufacturer of petroleum products, has an established corporate information system and electronic data interchange program. Most of Chevron's information is processed on a mainframe-level platform that includes its repository of MSDSs. Chevron implemented its EDI program several years ago at the request of a large customer but has never exchanged material safety data sheets using EDI. Mr. Steve Bosso, of Chevron Information Technology Division, has led the effort necessary to extract the MSDS data from the mainframe, structured in the ANSI Z400.1 format, and convert it to an electronic MSDS consistent with the structured X12 848.

Symtron Systems is a small manufacturer (less than 100 employees) of fire-fighting training equipment and supplies. Symtron provides the Navy with a product used in dispersing smoke resulting from shipboard fires, purchased primarily through FISC Norfolk. Symtron has no established corporate information system other than individual PCs, and had no previous exposure to EDI. Symtron's MSDSs are in hard copy and were developed prior to the establishment of the ANSI Z400.1 *Standard for Hazardous Industrial Chemicals — Material Safety Data Sheet Preparation*. We have provided Symtron with the software and training necessary to implement an EDI program for exchanging MSDSs.

VALUE-ADDED NETWORK

A value-added network can provide the networking necessary to link trading partners along with various services to enhance EDI exchanges. For the purposes of trading with a large company with many trading partners, such as

Chevron, a VAN is a necessity and was used in the prototype. Conversely, a VAN may not be necessary when trading with Symtron, which currently has no other trading partners. This applies only to the transaction volume expected during a prototype, however.

The operational scenario would use a VAN for all trading partners as well utilizing the Navy and DISA communications architecture and translation assets. Instead of linking directly to the VAN, NEHC would retrieve an MSDS in the form of a user-defined file from a regional translator, currently referred to as a DISA EDI Gateway. This DISA EDI Gateway receives files from a DISA Network Entry Point which, in turn, retrieves the file from the VAN.[2]

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[2] For a complete description of the Navy and DISA EDI architecture, refer to the *Navy Strategic Plan for Electronic Data Interchange*, May 1995.

# CHAPTER 3

# Project Results

Two manufacturers successfully transmitted MSDS information to the focal point data base, proving that EDI is a viable medium for exchanging such information. This chapter provides an overview of both the mechanics of data transfer and considerations in prototype development.

## OBSERVATIONS ON THE PROCESS

This section describes the processing required on the part of the sender and the receiver.

### Manufacturer Storage of MSDSs

Chevron stores its MSDS information as text files residing on a mainframe computer. A Chevron programmer used a data base programming language (NOMAD2) to extract the data in a "flat file" or "user-defined file" format. Because the source was a simple text document, he created a program that extracted the file and parsed the data based upon content. This provided the data discipline necessary for sending the structured version of the ASC X12 848.

The parsed flat file was then routed to the corporate translator via job control language (JCL) for conversion into ASC X12 848 format. Translation and file transfer to the VAN was automated, and the process from flat file extraction to EDI file receipt in the Navy's VAN mailbox took less than 15 minutes.

Chevron's programmer indicated that the effort required approximately four man-months of analysis and programming. Most of this time was dedicated to creating the parsing program necessary to convert the text into a structured transaction. While this represented a unique challenge, the programmer was greatly aided by two factors. First, Chevron's MSDSs are consistent with the American National Standards Institute (ANSI) Z400.1 *Standard for Hazardous Industrial Chemicals – Material Safety Data Sheet Preparation*. Second, Chevron has an established EDI program, which allowed the programmer to concentrate on flat file generation. In general, many of the Navy's larger trading partners would likely find a similar experience.

The Navy also purchases significant quantities of hazardous material from smaller trading partners, however. A small company's information processing generally requires no more than a PC, or, increasingly, PCs supported by a network. In the case of Symtron Systems, Inc., we provided the software necessary

for electronic storage. Commercial off-the-shelf software is available for MSDS management by PC. It is not known, however, how many Navy trading partners currently manage a material safety data sheet as a record in a data base management program, as a word processing file, or as a hard copy. In any case, the process of data extraction and conversion to electronic data interchange is sufficiently difficult to surpass the programming capabilities of most smaller companies.

As the need for this process increases, through increased demand for electronic MSDSs, it is likely that off-the-shelf software will address the requirement. In the short term, however, most trading partners would rely on a value-added service to convert their data into an electronic data interchange format.

## Data Transfer and Download

As indicated, Chevron used an automated process for translation and file transfer to its VAN, which in this case was General Electric Information Systems' EDI*EXPRESS Service. We agreed to use the same VAN to avoid charges from third-party interconnect services. EDI*EXPRESS Service is also one of the largest service providers.

Before data transfer could take place within the VAN, a trading partnership had to be set up with Chevron. Both parties identify their interchange qualifiers and party names to the VAN, as shown in Figure 3-1. When the VAN receives an ASC X12 transaction, the system finds the ISA (interchange control header) segment and identifies the sending party in ISA06 ("CHEVMSDS" in this case) and the receiving party in ISA08 ("USNEHC" for the U.S. Navy Environmental Health Center). This concept differs slightly from the concept of a fixed "mailbox." Instead of a fixed address, as in E-mail messaging protocols, these names can vary with any and all trading partnerships established, as long as the VAN knows what aliases each party will use.

ISA06 (Sender's name)          ISA08 (Receiver's name)

```
ISA\00\     \00\     \ZZ\CHEVMSDS     \ZZ\USNEHC     \950504\
1246\U\00300\000000005\0\T\~
GS\MS\CHEVMSDS\USNEHC\950504\1246\5\X\003050
ST\848\500000001
BMS\00\930407\EN\000513\15
DTM\102\930407
N1\MF\CHEVRON USA PRODUCTS COMPANY\1\D&BNUMBER
-------{MSDS Detail}
SE\237\500000001
GE\1\5
IEA\1\000000005
```

**Figure 3–1.**
*ASC X12 848 Transaction*

Upon verbally confirming with Chevron that it had sent an MSDS, we accessed the VAN via a local telephone number using a modem and a communications software package. After logging on and providing our password, we accessed the data transfer menu and confirmed that our mailbox had one (or more) messages. Upon command, the system bundled the messages (if more than one) into a single file and awaited our data transfer command. Using the XMODEM file transfer protocol and a transmission rate of 9600 baud, a single MSDS took less than 40 seconds to download from the VAN to our PC.

In the operational scenario, NEHC would not interact with the VAN directly. The administrator of the regional translator would be responsible for handling most of the trading partner and VAN connect and interconnect issues, as well as administering batch access to the VAN. NEHC would have to coordinate, however, with the administrator of the regional translator to determine frequency of data access and availability, particularly if a purchase were being held up pending MSDS submission.

## VAN Service and Cost

The VAN service proved to be reliable, if not completely intuitive or user-friendly. The basic procedures, once learned, were quick and easy to execute. We did have some trouble interpreting the download file if it had been bundled from more than one input file. While the translator can accept bundled transactions, the application will not. Our solution was to manually unpackage the file into individual transaction files using a text editor.

Because of the extremely light mailbox volume we expected, we selected a billing plan with a smaller fixed fee and a relatively high variable cost based on kilocharacter throughput. The typical MSDS is approximately 15 kilocharacters in length, which equates to roughly $4.50 per document received. The actual rate applicable to the Navy will be much smaller based upon discounts and billing at operational volumes. The sender pays a similar fee based upon its own billing plan.

## Translation

After a file had been downloaded from the VAN into a specified directory on our computer, we then converted the EDI transaction into our user-defined file specification using the translator. The translator proved to be reliable, and the mapping solution seemed to be robust. We experienced minor difficulties initially with the interpretation of the implementation convention, but we resolved these by simple modifications to the mapping solution. Because the translator can maintain a mapping file for each trading partner, this increases flexibility and can be used to fine-tune for trading partner differences. Figure 3-2 illustrates part of a user-defined file resulting from translation.

```
Chev01  0100040793000513           0015             040793
Chev01  02MFCHEVRON USA PRODUCTS COMPANY   1 D&BNUMBER    ENVIRONMENTAL, SAFETY, &
Chev01  05MGCPS2161XX
Chev01  17                1.00C12
Chev01  18SECTION 1.00;CHEMICAL PRODUCT AND COMPANY IDENTIFICATION FOR : 100% JET FUEL
------- {MSDS Detail}
Chev01  18SECTION 16.00;DISCLAIMER FOR : 100% JET FUEL
Chev01  18THE ABOVE INFORMATION IS BASED ON THE DATA OF WHICH WE ARE AWARE AND IS BELIEVED
```

**Figure 3–2.**
*Typical User-Defined File (UDF)*

# Record Upload

The translator creates a fixed-length flat file that the PLASMA application program uses to upload the record into the data base. Microsoft Access has a built-in import application for reading fixed-length files based upon a specification the user provides. A significant amount of programming in Access Basic was required, however, to fully automate the process of populating all the related tables.

During the upload process, a single file is selected for import into the application. Because of the complex queries and record generation programming executed, a typical MSDS takes approximately 15 seconds to fully populate the designated tables.

# General Observations

The technology and process proved viable and efficient for populating a trading partner's data base with an electronic MSDS. The entire process, from data extraction to data receipt and uploading by the Navy, could occur in less than 15 minutes. This represents an enormous improvement in time and resources compared with current processing.

Chevron has also demonstrated the feasibility of converting a text file into a structured transaction. Its program solves the fundamental problem of incompatible data storage methods by bridging the gap between text files and data base records. Smaller companies, however, do not have the programming or EDI resources available to support such programming. A low-cost solution exists in the form of a service provider who will convert a trading partner's document into an ASC X12 transaction.

A better solution will become available when low-cost software for MSDS management supports a structured EDI transaction. This is not likely to occur, however, until the need is created by large customers, such as the Navy, requiring electronic MSDSs.

# RELATIONAL DATA BASE

A relational MSDS data base demonstrated that automation provides a significant advantage over a mechanical process. Specifically, the data base provides a wide range of functional utility to the focal point, including the following:

◆ Establishing a relational data base design that will improve MSDS data quality

◆ Automating the input of MSDSs into the focal point data base

◆ Reducing focal point operating costs by limiting manual data entry

◆ Checking that a new MSDS transaction is not already in the existing master data base prior to acceptance

◆ Managing a wide variety of MSDS transactions, including structured, semistructured, and unstructured EDI formats, other text formats, scanned text, and hard copy

◆ Facilitating data entry for those MSDS transactions that are not already in the existing master data base

◆ Facilitating the review and editing of data already in the master data base

◆ Facilitating the printing of entire MSDS documents in a format suitable for quick reference and display, should a hard copy be necessary

◆ Providing a user-friendly means to conduct both predefined and ad hoc queries against the master data base

◆ Providing the basis to export MSDS data electronically to an HMIS-compatible format, either on-line or via floppy disk.

We present our findings on some of these points in more detail below

## MSDS Hierarchy

The hierarchical relationship of data within an MSDS is not formally defined by existing regulations and policies. While the absence of a hierarchical structure provides broad flexibility in preparing an MSDS, a relational data base requires that the hierarchical structure of data be precisely defined. Consequently, we were forced to infer the hierarchical relationship of MSDS data. We did this by reviewing Federal Standard 313 (which identifies MSDS data requirements), the ANSI Z400.1 standard, and a sample of actual MSDSs prepared by various manufacturers using different formats.

The prototype data base reflects the inferred relational hierarchy for the MSDS data transmitted by EDI transaction. The relational hierarchy is established by parsing the MSDS data to various tables and linking each of the tables to one or more tables through key fields resident in each of the linked tables. Figure 3-3 shows the entity relationship diagram for the prototype data base.
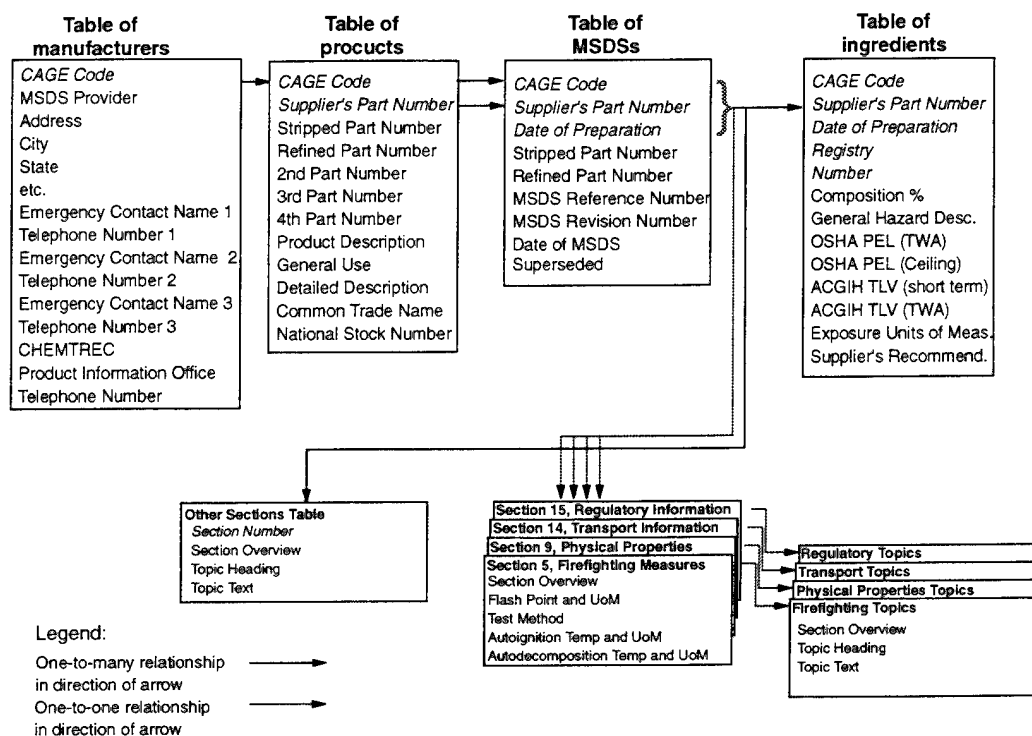


**Figure 3–3.**
*Entity Relationship Diagram*

The table containing manufacturers' data is at the head of the hierarchical structure. A single manufacturer identified by CAGE code may be linked to one or more products identified by supplier's part number. Each product may be linked to one or more MSDSs, the most current MSDS on file and previous MSDS submissions, as distinguished by the date of preparation. An MSDS may be linked to one or more ingredients identified by the Chemical Abstract Services or National Institute of Occupational Safety and Health number and also to each section of the MSDS identified by section number.

For design purposes, the sections, as defined by the ANSI Z400.1 standard, can be classified as following one of several patterns. The first pattern is that of a section header followed by one or more subsections, with each subsection having one or more topics and related information or warnings. We were able to create a single table to incorporate each of these sections as a one-to-many-relationship with the main MSDS record. The other sections (Section 5, Firefighting Measures, for example) do not follow a consistent pattern, and we created separate

3-6

tables for each of these four sections. We set these tables up as a one-to-one relationship with the main MSDS record, as indicated in Figure 3-3.

The use of one-to-many relationships affords significant flexibility in accepting various MSDS formats, provided the MSDS is at least loosely based upon the ANSI Z400.1 standard. Conversely, any table or field that is "hardcoded" into the design restricts this flexibility. For any future application based upon this design, we would recommend further use of the one-to-many relationships between tables. For example, in Figure 3-3, the emergency contact fields should be moved from the table of manufacturers into a separate table using a many-to-one relationship with the table of manufacturers. Similarly, the exposure fields in the table of ingredients should be set up as a separate table with a many-to-one relationship with the table of ingredients. In this way the application could accept any number of emergency contact references (or exposure guidelines) instead of a predefined limit of five, for example.

MSDSs submitted by the manufacturers that participated in the prototype testing fit neatly into the hierarchical relationship established by the prototype data base. However, lacking a standard for preparing MSDSs prior to the development of the ANSI Z400.1, manufacturers and vendors have more than likely created hierarchical structures for their MSDSs and included data fields that cannot be accommodated by the prototype data base. The prototype test did not reveal this problem since it involved only two manufacturers. This potential problem will be resolved only by the universal endorsement of acceptable data fields and a hierarchical standard.

## Logic Diagram for Appending New MSDSs

Our review of the procedure for determining the uniqueness of each MSDS submitted to the Navy's processing focal point revealed that it was performed manually and that it keyed on the following three data points:

◆ Supplier's part number

◆ Supplier's CAGE code

◆ Date of preparation of MSDS.

The data base performs this function automatically according to the logic in Figure 3-4.
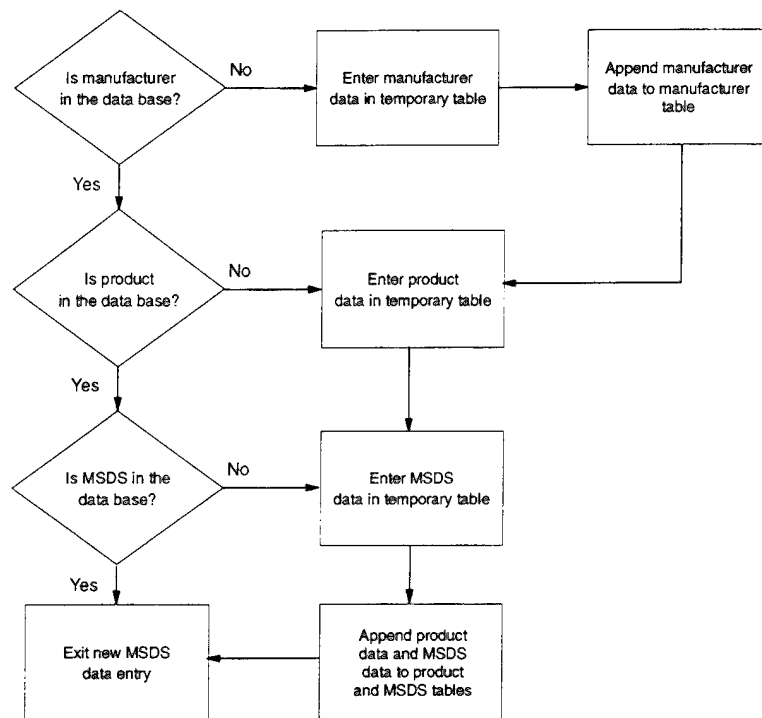
**Figure 3–4.**
*MSDS Verification Logic*

The data base accepts the supplier's part number as transmitted and stores it as "supplier's part number." It also removes nonsignificant characters such as "Mil Spec" and stores the data as "stripped part number." Finally, it standardizes any nonsignificant characters, adds those standardized characters to the significant characters of the part number, and stores the data as "refined part number." This process assists part number searches by eliminating the need to know how the manufacturer or supplier constructs its part numbers. The data base also allows storage of three additional supplier part numbers.

In addition to precluding the appending of duplicate MSDSs to the data base, this logic diagram also eliminates the need to append manufacturer data, if the manufacturer has previously submitted an MSDS for one of its hazardous products, or product data, if a previous version of the product's MSDS with the same part number had been submitted.

The data base was not populated with data prior to first receipt of MSDSs from manufacturers that participated in the prototype test. Consequently, all EDI-transmitted MSDSs were accepted by the data base. To test the ability of the data base to screen out duplicate data, we attempted to reappend the previously accepted MSDSs, and the data base appropriately indicated that the manufacturers, products, and MSDSs were already resident.

The supplier part numbers submitted by the manufacturers during the prototype test did not contain nonsignificant characters, so the data base stored the

same part number as both the "stripped part number" and the "refined part number." None of the submitted MSDSs contained more than three additional supplier part numbers, so the data base accommodated the transmitted part number data.

## Printing MSDSs

The ability to print MSDSs from the data base is provided by the report writing feature of the Microsoft Access software. We created a report shell for the prototype based upon the ANSI Z400.1 standard. When the MSDS print function is selected, data for the selected MSDS automatically populates the shell, and the MSDS can then be viewed on the screen or printed.

Because of the lack of standardization and actual quantity of data contained in each MSDS, the report display program is one of the most complex operations the application performs. Many calculations determine the existence or absence of data in each section and subsection, seriously taxing the report generating capabilities of Microsoft Access. On a PC configured with a 486-100 MHz microprocessor and 16 megabytes of RAM, the process of displaying an MSDS took approximately 50 to 60 seconds.

Because the application will support links to external objects, an alternative or supplement to generating a standardized report could be referencing an electronic image for each MSDS record. After an MSDS has been imported into the data base, NEHC personnel could scan an image of the manufacturer's MSDS and attach a link to the image file in the data base. Anyone desiring to see an image of the actual MSDS could do so with a single click of the mouse button. This would combine the data management capabilities of the data base with the security of maintaining a true image of the trading partner's MSDS.

## Network Processing

The prototype concept envisions that activities involved in processing MSDSs can remotely access the data base to query records, and view or download data. The focal point data base system can run as a host so that an activity with a computer, a modem, and remote control software can remotely operate the focal point computer to perform selected functions.

This function was not actually tested during the prototype operation, but using a host computer from a remote site with commercially available software is a well-established practice. The only unresolved issue regarding network processing is the number of activities that should be given access to the focal point data base. Resolving this issue will determine the computer processing requirement.

# The Current Environment

In our search for viable trading partners, we encountered over 50 manufacturers and vendors in varying stages of information automation. Their enthusiasm at the prospect of conducting business electronically was unanimous. They quickly recognized and embraced the potential benefits of reduced paperwork and increased speed of contract award. Most expressed interest in participating in the prototype.

In contrast to their enthusiasm was the reality that few manufacturers and vendors knew much about EDI, and some did not use computers in their business process at all. Many, however, did use automated data processing tools extensively, but did not use EDI. The few that used EDI tended to be the very large corporations where the marginal startup cost of an EDI program was trivial, and where economies of scale yielded quick paybacks. Finally, none were exchanging MSDS information via the ASC X12 848 implementation convention developed by the joint PIDX/CIDX committee.

In the next several years, however, government contractors will come under increasing pressure to conduct business electronically. As of the date of this report, the implementation conventions using the ASC X12 848 are being considered for adoption as Federal guidelines by the Federal Standards Committee. Because the MSDS business process is closely associated with the procurement process, it is likely to be incorporated into a new, reengineered electronic process using EDI. At that point, trading partner enthusiasm for exchanging MSDSs via EDI should increase dramatically.

Although EDI is a viable and efficient medium for exchanging MSDS information, it is some time away from maturing into the industry method of choice. Indeed, the Navy's trading partner base represents a wide variety of technological capabilities, many not yet sophisticated enough to use EDI. The Navy should endeavor to accommodate that range and grow along with it. EDI is one method to exchange MSDS information that is destined to gain market share as translation software and VAN costs decrease, and the Navy needs to include it in its portfolio of electronic exchange options.

CHAPTER 4

# Recommendations

## ELECTRONIC PROCESSING

We recommend that the Navy use EDI as a vehicle for the electronic transmission of MSDSs, and that it pursue a strategy for converting the current paper-based MSDS processing system to a fully electronic one.

Two of the largest industry groups involved with the manufacture and distribution of hazardous materials (PIDX/CIDX) have reached consensus on the formats for exchanging MSDS data using EDI. They are the unstructured, semistructured, and fully structured versions of the ASC X12 848 transaction set. Of the three implementation conventions developed by PIDX/CIDX, the fully structured ASC X12 848 allows the most detailed parsing of data. That feature permits the fullest application of data base management capabilities, including queries, management reporting, and data export to other automated systems that require hazardous material management data input. For that reason, we recommend use of the fully structured format to the greatest extent possible.

## PROGRAM MANAGEMENT

The Navy must approach further implementation of electronic MSDS processing with a well-defined strategy which ensures evolution consistent with Navy and trading partner capabilities and requirements. We recommend the Navy formally establish responsibility for the development of this program. Close coordination is required among many organizations, internal and external to DoD, and functional areas, especially procurement. In addition, many technical issues remain which must be addressed before the Navy can pursue full-scale implementation. We address some of these issues in this chapter.

## SOFTWARE

While the system developed for the purpose of the prototype can accommodate current transaction volumes, we recommend that the Navy fully evaluate the prototype system to determine additions, deletions, or modifications to its features. In addition, the Navy should consider process changes, user volumes, and data volume before attempting to implement a fully operational electronic system for MSDS collection and data distribution. Based on that evaluation, the Navy should develop a detailed requirements list and request competitive bids

to develop software with the desired features. Suggested functional improvements which both PLASMA and Microsoft Access can support include:

♦ External object reference to scanned images of the manufacturer's MSDS

♦ Automating the check for duplicate MSDSs and for the presence of mandatory data

♦ Increased flexibility in data base design through greater use of one-to-many table relationships

♦ Exporting user-defined files for the purpose of sending intra-DoD structured MSDSs.

# HARDWARE AND COMMUNICATIONS

Before the Navy can begin accepting electronic MSDSs, the Navy must first satisfy the basic hardware requirements and establish the communications path necessary to conduct electronic commerce. These requirements include:

♦ *Establishing a host PC for the data base application (PLASMA).* PLASMA requires a 486-class PC (or better) with at least 12 megabytes of RAM and a 17-inch high resolution monitor.

♦ *Implementing a local area network (LAN) at NEHC.* This will permit multiple users access to a common data set and allow for parallel processing of MSDS records.

♦ *Establishing a communications path.* This can be as simple as attaching a modem with a dedicated telephone line to the host PC.

♦ *Acquiring translation services.* For continued development of this prototype, we recommend using the Navy's own test and development gateways for translation, communication, and trading partner registration. For the fully operational scenario, however, the Navy must coordinate with DISA for these services.

# SOLICITING TRADING PARTNER PARTICIPATION

We recommend that the Navy aggressively seek out trading partners who are willing and able to exchange MSDSs using EDI. The Navy should evaluate potential procurement sites based on MSDS volumes, existing EDI capabilities, and relationships with selected commercial trading partners. It should enlist the support of major trading partners in encouraging the use of electronic commerce throughout their respective procurement and distribution chains.

The Navy should:

♦ Use trade journals, workshops, and other public forums to publicize the benefits of using EDI to exchange MSDS information

♦ Integrate the material safety data sheet into the procurement process, using the contracting mechanism as a tool to encourage the use of electronic commerce

♦ Offer financial incentives (e.g., lowest bid +x%) for participation

♦ Brief buyers so that they may encourage contractors with whom they do business to participate.

Because many Navy trading partners must overcome the hurdle of structuring a text, or even hardcopy, MSDS, the Navy should encourage technologies which can overcome this problem. The Navy should also encourage manufacturers and vendors to use service organizations that would convert supplier MSDS records into electronic data bases.

Finally, establish an "MSDS center" and a toll-free number to advise and assist interested companies on how to participate in this program.

# OVERCOMING BARRIERS TO IMPLEMENTATION

Current policies and procedures were designed to regulate a paper-based process. To fully realize the benefits of electronic MSDS processing, certain policies and procedures need to be modified. We recommend that the Federal Acquisition Regulation (FAR), Federal Standard 313, Code of Federal Regulations, and DoD and Navy policy documents related to MSDS processing be reviewed to identify changes that should be pursued in order to process material safety data sheets in an electronic architecture.

The Navy's MSDS processing system of the future must interface with existing and emerging Navy and Office of the Secretary of Defense (OSD) systems. We recommend that the Navy conduct an analysis to determine interface requirements of other systems and build those requirements into the MSDS processing system.

# PROTOTYPE EXPANSION

As the concept of distributing MSDS data becomes more mature, the Navy should consider a scheme that best leverages its advantages. To the prototype one would add

◆ a requisition filtering mechanism, in an attempt to reduce the use of hazardous materials when the requirement is identified,

◆ a central translation gateway, to limit systemwide programming and maintenance costs,

◆ and an electronic commerce procurement relationship that speeds and simplifies the contract award process. This expanded implementation is depicted in Figure 4-1.



**Figure 4-1.**
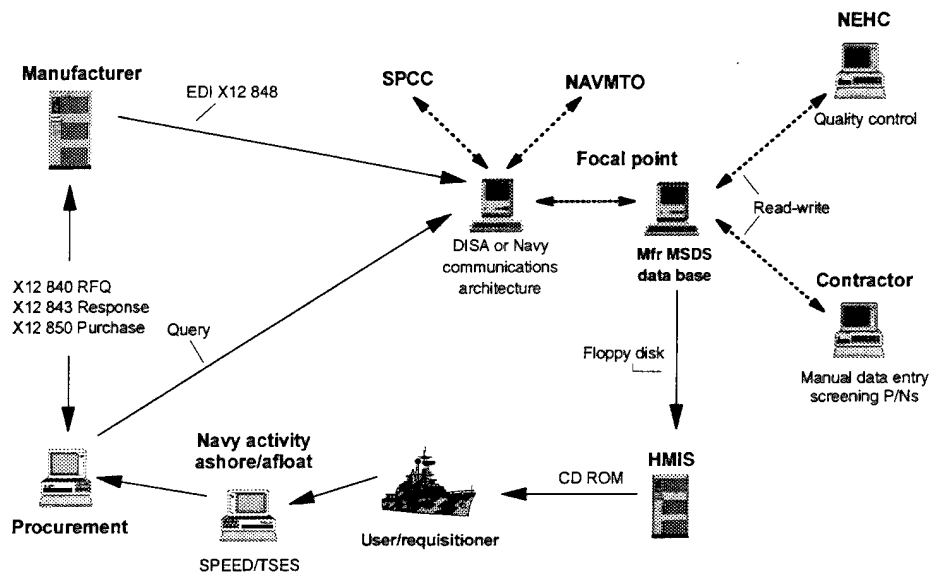*Expanded Implementation*

To the expanded implementation, one would add the concept of truly distributing MSDS data electronically. The goal is to collect it once, never rekey, perpetuate the data through the hazardous materials life cycle, and give diverse users access to the information they need. This fully integrated method of collecting, managing, and using MSDS data is depicted in Figure 4-2.
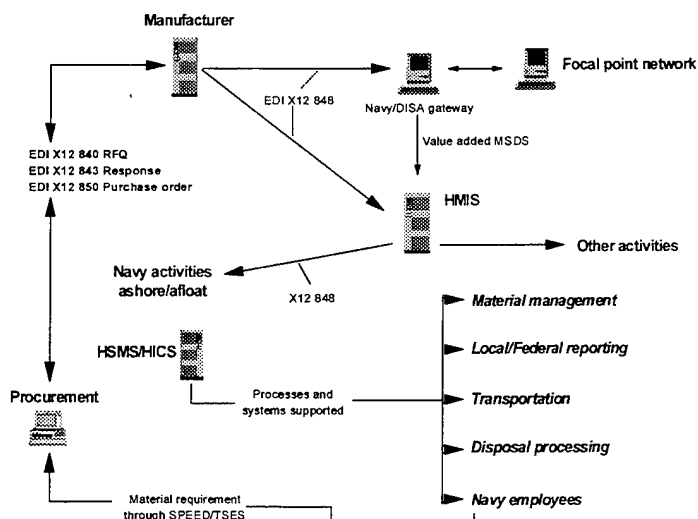
**Figure 4-2.**
*Full Implementation*

# SUPPLEMENTAL TECHNICAL OPPORTUNITIES

While EDI has been proven as an efficient and reliable vehicle for the exchange of material safety data sheets, other forms of electronic exchange should be studied for feasibility. Several other emerging technologies and standards may permit a more diversified portfolio of methods for exchanging electronic documents. Electronic data interchange still offers the Navy the most utility for populating an automated data base, but based upon trading partners' capabilities and source document storage methods, these other technologies and standards may permit the Navy to move to an electronic process faster than by relying on EDI alone.

1.  *Standard Generalized Markup Language (SGML).* SGML provides interesting opportunities for document storage and transfer. In contrast to EDI, which focuses on business transactions, SGML's strength lies in storing and retrieving reference materials, such as technical drawings. When trading partners use a common document type definition[1] (DTD), they can exchange documents electronically with markups that define not only what information the document contains but exactly how it looks as well. Fonts, spacing, point size, and other layout characteristics in the DTD permit the document to be identically reproduced at the receiving trading partner's data base. Additionally, a repository of documents using SGML tags can duplicate some functions of a data base, such as conditional querying. SGML does face some of the same obstacles to implementation as EDI, however. These obstacles include both the hardware (a high-end PC) and software necessary to set up an SGML workstation. In addition, a common or de facto DTD must be established for MSDSs, and because SGML is so relatively new to

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[1] A DTD is an agreement between trading partners for the use of an SGML document. It is analogous to an EDI implementation convention (IC).

the business community, it may be several years before an accepted format is adopted and used, if ever. Still, the Navy should explore the potential for using SGML to augment its data collection processes.

2. *ASCII or pure text transfer.* An MSDS stored as a word processing text file represents the lowest common denominator in electronic exchange and retrieval. Many organizations store material safety data sheets as electronic documents created using commercial word processing software. These documents can easily be converted to ASCII, essentially making them software-independent. The converted document can then be forwarded to the Navy via Internet, for example, using one of the common methods such as file transfer protocol or simple mail transfer protocol.

The more difficult task, however, is reducing this undisciplined data into the discreet tables and elements used by the DoD for MSDS storage. One proven method is to cut and paste the data into appropriate locations within the data base. While somewhat time-consuming, the method perhaps offers advantages over strict data entry.

An alternative is to explore the feasibility of using a "parsing engine" program. The parsing engine searches an ASCII document looking for keywords that match section headings and discreet elements within sections. With some intervention, the parsing engine can somewhat automate the task of cutting and pasting by identifying how the data should be segregated. Because of the wide variety of MSDS formats being used, the existing versions of parsing engines we have seen demonstrated are crude at best. As the range of different MSDS formats converge in the near future, however, the concept may prove viable.

3. *Optical character recognition (OCR) scanning.* As technology improves, OCR scanning may become a more viable method of MSDS input. The current generation of scanners are still dependent upon the original document condition and require error detection and correction after input. While scanning can potentially speed the process of data input, the document is still transferred via fax or mail. Image scanning, not OCR, can perhaps augment another form of transfer, such as EDI, by providing an accompanying picture of the document.

All of the methods listed can help to increase the Navy's ability to quickly and accurately process MSDSs while relying on fewer external resources. The Navy should not seek to choose a single technology or method, as they are all complementary. EDI has made the most progress to date toward moving MSDSs electronically between trading partners and also offers the Navy the most utility in the form of cost savings. Other methods, including those mentioned, may offer added capability at marginal cost and should be studied accordingly.

# APPENDIX A

# Feasibility Study

*This portion of the report was written at the onset of the project and reflects the analysis performed prior to development of the prototype. It is meant to provide insight into the development process, but because it reflects information prior to actual development, it does not contain recommendations regarding any part of the Navy hazardous materials program.*

## PRELIMINARY ANALYSIS

### Problem Definition and Opportunity

The Navy's focal point receives material safety data sheets (MSDSs) only in hardcopy format. As a result, personnel must process a large quantity of paper and expend significant resources performing data entry. The word processing application used is very basic and allows only for minimum use of automation. In addition, data transfer between focal point, subfocal points, and external parties is entirely by mail. The resulting process is slower and more resource-intensive than necessary.

Converting this process to an electronic one with more sophisticated software and data management techniques could save both time and money. Specifically, use of the ASC X12 848 MSDS between Navy trading partners and the focal point would eventually result in near-complete automation.

Other emerging technologies may facilitate the Navy's ability to capture data electronically instead of by paper. Use of Standardized General Markup Language (SGML) may allow the Navy personnel to further manipulate or structure text files into data base-compatible files with a minimum of effort.

### OVERALL OBJECTIVES

Our primary objective is to establish a working prototype of a system capable of capturing electronic MSDSs submitted by Navy trading partners. While a typical prototype may only validate a concept, we intend to pursue this as an evolutionary system which could become the focal point's primary method of data collection, editing, and eventual submission to Hazardous Material Information System (HMIS). For the purpose of this project, our concept of a "system" is generally limited to a standalone software package.

Specific characteristics of the system should include the ability to:

◆ Network and share data among geographically dispersed activities.

◆ Significantly reduce the requirement for manual manipulation of data.

◆ Support DoD and Navy's goals of moving to the integrated Hazardous Substance Management System (HSMS).

◆ Interface with as large a segment of the Navy trading partner population as economically feasible.

◆ Significantly decrease the time required to process MSDSs into HMIS-compatible format.

The accomplishment of these objectives are beyond the scope of this project. We are instead seeking to provide the Navy with a system which can be expanded upon, improved, and used as a means toward fulfilling these goals.


## SYSTEM USERS

The system may eventually be networked to include other facilities, but the primary users will be the focal point personnel. In all likelihood, however, the limited resources available to the focal point may instead require installation at the contractor's facility. Ideally, both locations would be setup. The politics of this present some risk, and we may have to approach this from several directions.


## DATA FLOW DIAGRAM

In this example, Figure A-1, the high-level data flows are shown. There are at least two paths from trading partner to focal point (not including hard copy). Currently the data will leave the focal point only in the form of a floppy disk to HMIS.

Figure A-2 details data flow at the focal point to include alternate forms of data capture, including direct entry into the word processing (or text editor) portion of the system. The front-end receives incoming data, passes it to the word processing application for manipulation and quality control. The data should leave the word processing in HMIS-compatible format. That is, the data elements and attributes should be consistent with those of the HMIS data base structure. Depending upon mode of entry, each record will require little to significant formatting.
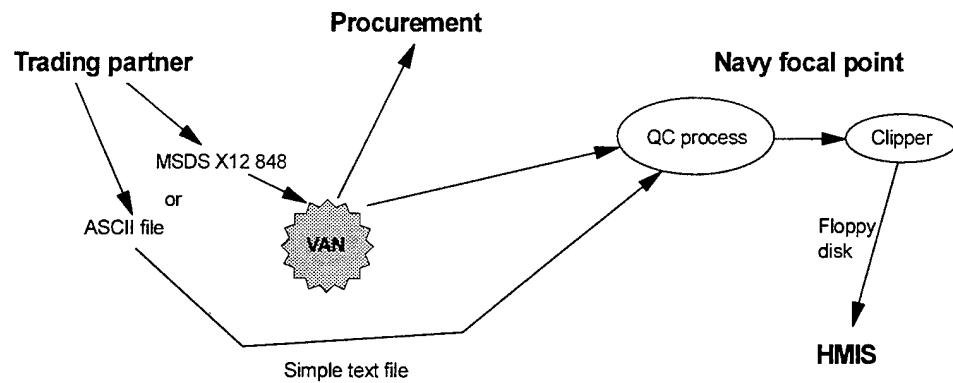
**Figure A-1.**
*Level 0 Data Flow Diagram (Macro Level)*
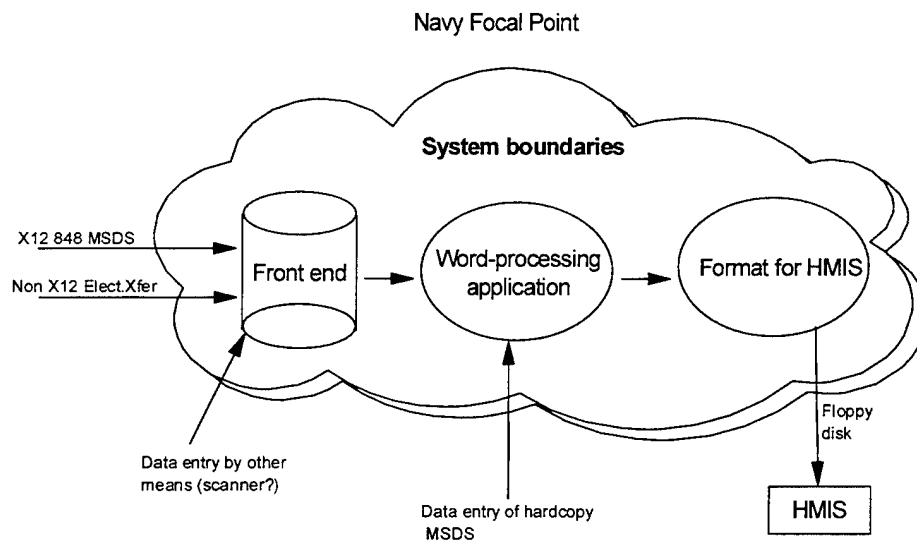


**Figure A-2.**
*Level 1 Data Flow Diagram (Focal Point Level)*

Figure A-3 illustrates the basic purpose of the front-end which is to receive the incoming file from a translator or other communications source, provide some structure to the data, and hold until required by the word processing application. Ideally the system could also sort duplicates and adds by comparing header information.
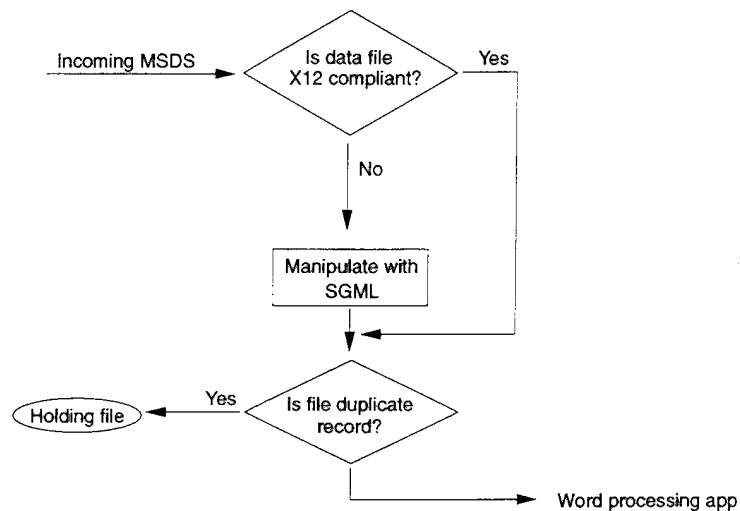
**Figure A-3.**
*Level 2 Logic for Front-End*

The data is passed from the front-end to the word processing application either as a structured, parsed data file, or as a generally unstructured, text-only file. In the case of the latter, the word processing would hold the text file while the system imposes previously defined structure, in the form of SGML or other parsing logic, to the document. Further manipulation to any file prepares the record for export in an HMIS-compatible format.
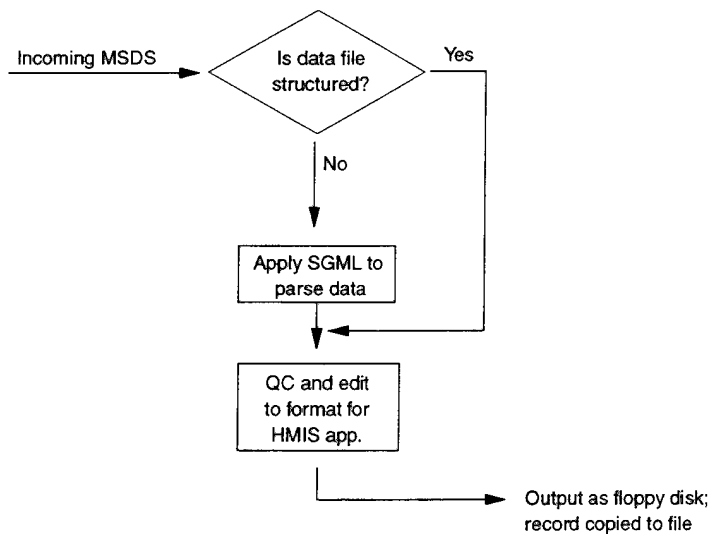


**Figure A-4.**
*Level 2 Logic for Word Processing Application*

# Primary Analysis

## PROPOSED ARCHITECTURE

We propose operating the system on a 486-class PC which would serve as the data base linked to a network of local PC's of similar power, each capable of running the application locally. We believe distributed processing techniques offer the most efficient use of computing resources. The file server could also serve as the telecommunications gateway for access by other networks, such as one running at a subfocal point. This gateway would also serve as the recipient of electronic records submitted by trading partners. As trading partner participation increases, more processing power may be required, and the communications module and data base management system may have to reside on separate platforms.

The primary network operated at the focal point would permit efficient workflow among those individuals adding value, screening, or performing edits. Records ready for added value from another network could be batch downloaded through the gateway to the subfocal point.

Several communication issues must be resolved prior to implementation. Generally these issues are beyond the scope of this document. The most notable exception, however, is that of translation software. The status of translation assets is currently in a state of flux.

## MAKE OR BUY ANALYSIS

Purchasing a system represents the quickest, easiest, and lowest-risk solution to satisfying minimum user requirements. However, based upon our requirements and desired system capabilities, finding a commercial package meeting all criteria is unlikely. Most systems address the requirements of an employer or manufacturer. The focal point, who is responsible for throughput, may not need all of the capabilities provided in some packages. For example, most systems act as the repository, a function served by HMIS in our case. Other features offer capabilities not currently required by the focal point but which may provide value in the future, such as environmental management capabilities.

Developing a system would result in a closer match of requirements and system features. There are serious uncertainties which arise in attempting to develop such a system, however. These include cost, time to complete, and value of end-product. Still, depending upon the software available off-the-shelf, development may provide the most efficient use of resources and result in a close match with user requirements. Obtaining a quote for coding, testing, and support based upon the completed version of the physical specification is worth exploring.

Other considerations for a make vs. buy decision will impact the acceptance of the system; for example, appearance and usability of end-product.

Presumably a commercial package would assign a premium to these attributes. We also believe that these attributes will influence the success of the project, and not simply from a functional perspective. A professionally-designed product that "looks sharp" will stand in contrast to many of the other applications run by the Navy and will impact on the emotional acceptance of the product.

Additional criteria include reliability and maintainability. Once again, it is presumed that commercial packages would be rigorously tested and designed in a high level, fourth-generation language which would facilitate its serviceability and upgradeability.

A third alternative is to customize a commercial package. Depending upon the degree of work required, this also opens up issues of cost, time, and reliability.

## PROJECT RISK ANALYSIS

Several issues pose varying degrees of risk to both the short- and long-term success of the project.

♦ Electronic data interchange (EDI) may not gain acceptance or momentum as the preferred electronic method for MSDS submission. While movement toward electronic format seems assured in the long term, EDI is not yet established as the overwhelming method of choice.

♦ The PIDX/CIDX implementation convention may not gain wide acceptance. While there is a possibility that a more fully-codified version may prevail, the PIDX/CIDX version offers a degree of codification which is consistent with HMIS's current abilities.

♦ We may encounter hardware requirements which we did not anticipate. For example, we do not know what computing capabilities Navy Environmental Health Center (NEHC) (or anyone else) has. We may encounter telecommunications issues such as dedicated phone lines, modem availability, or translation assets. Some of these issues can be solved easily and relatively cheaply. Most others are probably outside the scope of the project and are the Navy's responsibility.

♦ The system may not perform as advertised, in the case of a purchased package, or as specified, in the case of in-house development.

Most of these risk factors can be mitigated through strategy or planning. In the first case, as an example, we can explore several methods of electronic transfer or invest in a system flexible enough to accept various forms of data import.

The project is technologically, economically, and organizationally feasible. Our recommendation is to proceed ahead, mapping a strategy which will maximize the potential for short- and long-term success, as defined by our initial objectives, and minimize those risk factors identified.

Specifically, we need to identify the set of data transfer methods which will maximize the trading partner potential and make this a principle criteria in our system selection. Because one of our objectives is to establish a working prototype from which the Navy can build upon, we should explore the use of alternate technologies (such as SGML).

We should also begin surveying commercial off-the-shelf (COTS) as soon as possible. This will provide us with some critical information to include whether or not there is a package, in our price range, which can generally meet our minimum criteria. It will also provide us with a better understanding of what capabilities we require or may want in the future. Lastly, if we cannot find an acceptable commercial package, we will need as much time as possible to investigate our own system development.

While we want to provide a system with as much utility as possible, we also need to limit the scope of the project and reach an understanding with the client as to what tasks appropriately fall into our area of responsibility.

## Requirements Analysis

### SYSTEM INPUTS AND OUTPUTS

The system will be accepting inputs from several of a potential number of sources. These sources include electronic transfer via EDI, electronic transfer in ASCII format, manual data entry, import from existing data base, and scanned entry. The primary output will be the MSDS, in HMIS-format, downloaded as a floppy disk.

1. *Electronic Transfer via EDI.* Eventually the Navy should seek to move as much data as possible by EDI, primarily because it provides the most definition to the data structure and can result in nearly complete automated processing. The three guidelines currently recognized by the Navy include the unstructured, semi-structured, and structured conventions modeled after the PIDX/CIDX industry guideline. Mapping protocols must be developed for each guideline, although their location, internal or external to the system, is yet to be determined. When we survey the COTS we should gain a better understanding of how programs advertised as "EDI-compatible" interface with the translation software. There is the possibility that additional programming will be required to provide the bridge from flat file to application program.

2.  *Miscellaneous Electronic Transfer.* Many programs advertise the ability to import data via "electronic transfer." We need to understand what this specifically means, if there is a standard definition. In all probability, it is the transfer of an ASCII file via modem with a minimum envelope structure. Because this is a simple form of data transmission, and because most trading partners' data bases are set up as flat text files, this mode of transfer is open to a large segment of the Navy trading partner population. While it does not provide much structure or automation, the use of SGML may enhance its utility to the Navy and provide a "first step" toward all electronic processing.

3.  *Manual Data Entry.* In the near term, manual data entry will still dominate as the practical method of entering MSDSs into the system for HMIS-compatible formatting. Because the system should evolve into the Navy's primary MSDS management system, it must provide the entry screens capable of accepting keyed-in data. Most COTS packages accept this form of data capture.

4.  *Scanner Entry.* Another form of data entry is through the use of a digital imaging processing system. While a full-fledged imaging system is relatively expensive, the hardware necessary to perform Optical Character Recognition scanning is fairly inexpensive (around $1,500). Scanning hardcopy MSDSs into a system represents an efficiency over manual data entry, but it is not as efficient as any form of electronic transfer. Some COTS packages do support entry by scanning.

## Determining System Capacities

DATA VOLUMES AND USER VOLUMES

The current volume of paper MSDSs to the focal point is approximately 40,000 (gross) annually. At some point this may be reduced by process and policy changes that allow procurement activities to query for the preexistence of a record. In these cases, no MSDS would be required or submitted to the focal point. In this case, based upon a current 70% duplication rate, the inflow may be reduced to 15,000 or less annually.

User volumes are harder to estimate. In an architecture using distributed processing techniques, it is more useful to estimate using *networks* and then estimate the individual users on each. Initially, we plan on one to three networks with an average of eight users each. It is conceivable, however, that the system would feed more than two dozen facility networks, located across the country. This is a remote possibility, however, and is beyond the scope of the project.

# Appendix B

# Schedule for Implementing Prototype

This appendix provides a work breakdown structure in the form of a Gantt chart of the major tasks involved in the completion of the prototype. It incorporates the basic structure of systems development with the project requirements for any electronic data interchange (EDI) implementation. While the chart does not necessarily reflect actual time devoted to any individual task, it does give a general idea of relative effort devoted to each major requirement.

| Task Name | May '94 | Jun '94 | Jul '94 | Aug '94 | Sep '94 | Oct '94 | Nov '94 | Dec '94 | Jan '95 | Feb '95 | Mar '95 | Apr '95 | May '95 | Jun '95 | Jul '95 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**1 Conduct Feasibility Study** — 7/2

**1.1 Preliminary Analysis** — 6/1

1.1.1 Define the Problem or Opportunity — 100% 5/17 — /12

1.1.2 Establish Overall Objectives — 100% 5/17 — /12

1.1.3 Identify Users of System — 100% — /12 5/25

1.1.4 Establish Functional Scope (Data Flow Diagram) — 100% 5/25 6/1

**1.2 Primary Analysis** — 5/25 7/2

1.2.1 Propose General Options (Architecture) — 100% 5/25 6/10

1.2.2 Make or Buy Decision — 100%

1.2.3 Assess Project Risk — 100% 6/1 6/30

1.2.4 Recommendation to Proceed — 100%

**2 Perform Requirements Analysis** — 7/10 8/12

2.1 Determine System Outputs/Inputs — 100% 7/10 8/1

**2.2 Determine System Capacity** — 8/1 8/5

2.2.1 Estimate Data Volumes/User Volume — 100% 8/1 8/5

2.2.2 Determine Database capacities/capabilities — 100% 8/1 8/5

2.3 Survey Additional User Requirements — 100% 8/5 8/12

**3 Determine Conceptual (logical) Design** — 8/12 8/20

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Task ▬  Progress ▬  Milestone ◆  Summary ▼▼

Project: MSDS EDI Prototype
Date: 5/31/95

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| Task Name | May '94 | Jun '94 | Jul '94 | Aug '94 | Sep '94 | Oct '94 | Nov '94 | Dec '94 | Jan '95 | Feb '95 | Mar '95 | Apr '95 | May '95 | Jun '95 | Jul '95 |

Timeline months across top: May '94, Jun '94, Jul '94, Aug '94, Sep '94, Oct '94, Nov '94, Dec '94, Jan '95, Feb '95, Mar '95, Apr '95, May '95, Jun '95, Jul '95

3.1 Specify Hardware and Systems Software — 100% 8/12 — 8/20

3.2 Specify System Outputs and Inputs — 100% 8/12 — 8/20

**4 Develop Physical Design Specification** — 8/25 — 10/3

4.1 Identify Contractor — 100%

4.2 Submit Conceptual Design Documentation — 100% 9/1 — 9/15

4.3 Review Product and Change as Needed — 100% 9/15 — 9/25

4.4 Functional Specification Approval — 100%

4.5 Submit to NAVSUP for Review — 100% 10/1 — 10/3

**5 Application Development** — 10/3 — 1/20

5.1 Programming — 100% 10/3 — 11/15

5.2 Problem Identification and Rework — 100% 11/15 — 12/10

5.3 Initial Presentation to Client — 100%

5.4 Changes Based on User Input — 100% 12/16 — 1/20

**6 Develop Conversion Plan** — 11/1 — 3/1

6.1 Determine Conversion Strategy — 100% 11/1 — 3/1

6.2 Determine HW/SW Requirements — 100% 11/1 — 12/14

6.3 Identify Special Considerations — 100% 12/14 — 3/1

**7 Review Telecommunications Requirements and Develop Strategy** — 11/15 — 3/20

Legend:
Task | Progress | Milestone ◆ | Summary

Project: MSDS EDI Prototype
Date: 5/31/95

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| Task Name | Timeline |
|---|---|
| 7.1 Assess Hardware Requirements | 11/15 – 3/20, 100% |
| 7.2 Provide Contractor with Translator | 100% (diamond at ~3/1) |
| 7.3 Identify Solution for Translator | 12/1 – 2/1, 100% |
| 7.4 Establish VAN Agreement | 2/1 – 2/20, 100% |
| 7.5 Provide Contractor with MAKEUDF Program | 100% (diamond ~3/1) |
| 7.6 Resolve Telecommunications Issues (Hardware, Software, Office Infrastructure) | 100% |
| 8 Integrate and Test | 2/28 – 3/20 |
| 8.1 Determine & Develop Necessary System Application Links and Interfaces | 12/14 – 4/15, 100% |
| 8.2 Acquire any Additional Hardware | 12/15 – 3/20, 100% |
| 8.3 Exchange Trading Partner Information with TP(s) | 12/14 – 3/20, 100% |
| 8.4 Initial Exchange of Data | 3/1 – 3/20, 100% |
| 8.5 Evaluate and Modify | 100% (diamond ~3/20) |
| 8.6 Final Exchange of Test Data | 3/30 – 4/15, 100% |
| 9 Post Pilot Audit | 100% (diamond ~4/18) |
| 10 Generate 3 Volume Report for NAVSUP | 4/18 – 6/2, 100% |
| 11 Expand Trading Partner Participation | 4/17 – 6/2, 100% |
| | 6/1 |

Project: MSDS EDI Prototype
Date: 5/31/95

Task     Progress     Milestone ◆     Summary ▼

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# APPENDIX C

# Glossary

| | | |
|---|---|---|
| ASCII | = | American Standard Code for Information Interchange |
| ANSI | = | American National Standards Institute |
| ASC | = | Accredited Standards Committee |
| CAS | = | Chemical Abstract Services |
| CFR | = | Code of Federal Regulations |
| CIDX | = | chemical industry data exchange |
| COTS | = | commercial off-the-shelf software |
| DDN | = | Defense Data Network |
| DFAR | = | Defense Federal Acquisition Regulation |
| DGSC | = | Defense General Supply Center |
| DISA | = | Defense Information Sytems Agency |
| DLA | = | Defense Logistics Agency |
| DoDI | = | Department of Defense Instruction |
| DTD | = | document type definition |
| EDI | = | electronic data interchange |
| FAR | = | Federal Acquisition Regulation |
| FISC | = | Fleet Industrial Support Center |
| FPN | = | focal point network |
| FTP | = | file transfer protocol |
| GUI | = | graphical user interface |

| | | |
|---|---|---|
| HAZMAT | = | hazardous material |
| HICS | = | Hazardous Material Inventory Control System |
| HMIS | = | Hazardous Material Information System |
| IC | = | implementation convention |
| JCL | = | job control language |
| MSDS | = | material safety data sheet |
| NAVMTO | = | Navy Material Transportation Office |
| NAVSUPSYSCOM | = | Naval Supply Systems Command |
| NEHC | = | Navy Environmental Health Center |
| NLN | = | Navy logistics network |
| NSN | = | national stock number |
| OSD | = | Office of the Secretary of Defense |
| OCR | = | optical character recognition |
| OSHA | = | Occupational Safety and Health Administration |
| PCO | = | procurement contracting officer |
| PIDX | = | petroleum industry data exchange |
| PLASMA | = | Prototype Long Range Automated System for MSDS Management |
| RAM | = | random access memory |
| SGML | = | Standard Generalized Markup Language |
| SPCC | = | Ships Parts Control Center |
| SPEED | = | Standard Processing Environment for Electronic Documents |
| TSES | = | Technical Screening Expert System |
| UDF | = | user-defined file |

| | | |
|---|---|---|
| USNEHC | = | U.S. Navy Environmental Health Center |
| VAN | = | value-added network |

# REPORT DOCUMENTATION PAGE

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**13. ABSTRACT** *(Maximum 200 words)*

This report documents the results of a prototype commissioned by the Navy to study the feasibility of using electronic data interchange (EDI) as a vehicle for automating the exchange of health and safety information between commercial trading partners and the government. The results of the prototype suggest that the use of enabling technologies such as EDI can greatly improve the effectiveness and efficiency of the Navy's material safety data sheet (MSDS) process. Currently there is little use of EDI to exchange MSDSs among trading partners. As government EDI initiatives mature, however, the Navy can expect increased use of EDI for many business functions including hazardous materials communication. The Navy should therefore plan to implement EDI as a primary method of data collection. The Navy should also identify current and emerging hazardous material information requirements that may be satisfied through the use of an electronic MSDS. Finally, the Navy should identify other emerging technologies with the potential to improve health and safety data collection and distribution to Navy employees and systems.

**14. SUBJECT TERMS**

Material Safety Data Sheet (MSDS); Electronic Data Interchange (EDI); Hazardous Material (HAZMAT)

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